Polylactic acid/ Thermoplastic Starch/Montmorillonite Nanocomposite: Morphological, Tensile Properties, Water Absorption and Degradation Behavior

ESMAT JALALVANDI

Universiti Teknologi Malaysia

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Universiti Teknologi Malaysia

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To my beloved mother and father

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ABSTRACT

Polylactic acid/ Tapioca starch/ Montmorillonite nanocomposites were prepared with different loadings of nanoclay (MMT) via twin screw extruder then compressed into plates for using in various tests. The effects of different loadings of MMT on mechanical, thermal, morphological properties, water absorption and biodegradation behavior of nancocomposites were investigated. Tensile properties were studied as some mechanical properties through this research. The thermal properties were characterized by using differential scanning calorimeter (DSC). Morphological properties of nanocomposites were studied through field emission scanning electron microscope (FESEM) and x-ray diffraction (XRD). Tensile strength increased by increasing the percentage of MMT in polymer matrix. Optimum amount for Young's modulus and percentage of elongation at break were determined among the five samples and these results are in fine agreement with XRD results that prove the intercalated and exfoliated structure of nanocomposites. The results of DSC showed that MMT increased melting temperature and crystallization temperature of matrix but reduction in glass transition temperature was observed. During the water absorption test, amount of water intake decreased by increasing the content of MMT in nanocomposite structure. Biodegradation study exhibited that incorporation of this type of nanoclay has growing effect on degradation rate of nanocomposites.

ABSTRAK

Polylactic asid/ Tapioca kanji/ Montmorillonite nanocomposit telah disediakan dengan pembebanan yang berbeza nanoclay (MMT) melalui penyemperit skru kembar kemudian dimampatkan ke dalam plat untuk menggunakan dalam pelbagai ujian. Kesan pemebanan yang berbeza MMT pada mekanikal, hartanah, haba morfologi, penyerapan air dan kelakuan biodegradasi daripada nanocomposites disiasat. Sifat tensil telah dikaji sebagai beberapa sifat mekanik melalui penyelidikan ini. Sifat haba telah dicirikan dengan menggunakan meter kalori pengimbasan kebezaan(DSC). Sifat morfologi nanokomposit dikaji melalui pelepasan bidang mikroskop electron imbasan (FESEM) dan pembelauan sinar-X (XRD). Kekuatan tegangan meningkat dengan meningkatkan peratusan MMT di dalam matriks polimer. Jumlah optimum untuk modulus Young peratusan pemanjangan telah ditentukan di kalangan lima sampel dan keputusan ini adalah dalam perjanjian halus dengan keputusan XRD. Sifat haba telah dicirikan dengan menggunakan meter kalori pengimbasan kebezaan(DSC). Keputusan menunjukkan bahawa MMT meningkat suhu peralihan kaca diperhatikan. Semasa jumlah ujian penyerapan air, pengambilan air menurun dengan meningkatkan kandungan MMT dalam struktur komposit nano. Kajian biodegradasi mempamerkan bahawa penubuhan jenis daripada nanoclay ini telah berkembang kesan ke atas kadar degradasi nanokomposit.